

DOUTHITT

On the Anatomy and Systematic Position
of a new Species of Anoplocephaline
Cestode from the Pocket Gopher

Zoology

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ON THE ANATOMY AND SYSTEMATIC POSITION
OF A NEW SPECIES OF ANOPLOCEPHALINE
CESTODE FROM THE POCKET GOPHER

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BY

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A. B. University of Oklahoma, 1910

THESIS

Submitted in Partial Fulfillment of the Requirements for the

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May 31

1911

I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

Herman Douthett

ENTITLED *On the Anatomy and Systematic Position of a New
Species of Anoplocephaline Cestode from the Pocket Gopher.*

BE ACCEPTED AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE

DEGREE OF *Master of Arts*

James W. Ward
In Charge of Major Work

Head of Department

Recommendation concurred in:

} Committee

on

} Final Examination

Introduction.

While studying the anatomy of the pocket gopher at the University of Oklahoma during the school-year of 1909-1910 I found in the intestine of one gopher about forty specimens of a small cestode. I examined six other specimens which were on hand, one of which yielded thirteen additional specimens. Some of the material was sent to Professor Henry B. Ward for identification. He saw that they were of an unrecorded species, and as I had arranged to study at the University of Illinois the next year I decided, upon his suggestion, to study the anatomy of this form. The present paper gives the results of these studies.

The material from the first gopher was lost thru drying, except for five specimens sent to Professor Ward for identification. Efforts to secure additional material were unsuccessful on account of the extreme dryness of the season in western Oklahoma. The account here is based on the study of the thirteen specimens remaining in my collection and one of those in the collection of Professor Ward. All were in a very poor condition, as they had been taken from their hosts after these had been preserved for several months in formalin. By careful study however I have been able to make out with certainty the facts noted below; and it is my intention to complete these studies as soon as suitable material can be obtained. The material was studied chiefly from longitudinal and transverse sections, with various haematoxylin stains. For counter-staining acid fuchsin and eosin were tried, but neither of these had any effect upon the material.



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Marsipotaenia geomyos gen. nov., sp. nov.

Host, *Geomys breviceps* Baird. Locality, Norman Oklahoma.

The total length of the specimens at hand is from 30 to 33 mm. The number of proglottids varied from 55 to 80, the average being 68. The scolex averages 365 in diameter by 320 long, but exhibits a wide range of variability, due probably to the poor condition of the material. There is no neck. The first proglottids are 0.7 to 0.8 the diameter of the scolex and from one eighth to twelfth as long as broad. The maximum width of 1.7 to 2 mm. is reached about the middle of the strobila; back of this the width remains constant or decreases slightly. At the middle of the worm the proglottids are from one-fifth to one-third as long as broad. They increase in length as they become older, becoming finally two-thirds as long as broad. The thickness of the strobila, which varies greatly with the stage of contraction, may be said to be about 350 microns. The proglottids are all quite distinct from each other. All except the first half-dozen or so are narrower at the anterior end. The margin of the first half dozen is a regular curve; beyond this, it becomes obtusely angled, with the posterior limb parallel to the longitudinal axis. In those proglottids in which the eggs are being fertilized the large everted procloaca (to be mentioned later) protrudes prominently. The surface of the strobila may be thrown into a number of longitudinal folds, and there may be present also a deep transverse furrow near the posterior end of the proglottid.

The scolex is distinct from the strobila. It is somewhat four-sided in longitudinal outline, and is clearly separated into into an anterior and a posterior portion, the line of demarcation

being a slight transverse constriction near the middle. In some cases the anterior part will be broader than the posterior; in others the opposite is the case. The apex is blunt, the anterior outline being a regular curve. In cross section the scolex is seen to be rather deeply four-lobed, owing to the presence of four furrows between the suckers, of which the dorsal and ventral are much the deepest. All four fade out before reaching the apex.

The very prominent suckers face antero-laterad at an angle of about 45 degrees from the axis. The mouth is 25-40 microns in diameter and the cavity 70-90 microns deep. The muscular wall of the suckers is from 25-50 microns thick*.

It was impossible to make out much of the histological structure. A definite cuticula 5 microns thick is present on some of the specimens, but not visible on others. Very little could be made out about the muscular. No calcareous bodies are to be seen in any of the specimens.

The excretory ducts lie in about the same dorsoventral plane, the (originally) dorsal outside. The path across the proglottid is a curve, so that they diverge from the median line at the middle. The course is wholly free from windings and other irregularities.

The dorsal duct is usually from 10-12 microns in diameter at the ends of the proglottids. In the middle on the aporose side

* There is a great range of variability in all that concerns the scolex. In many individuals it is narrow and pointed, without trace of furrows or transverse constrictions. Many have also no trace of sucker muscles. These are probably to be explained as due to the condition of the material; at any rate the condition of the material does not justify conclusions based on negative characters

it narrows to 6-7 microns and on the porose to three. The ventral duct is 40-50 microns in diameter at the ends; in the middle on the aporose side it narrows to 30-35 microns, and on on the porose side the passage may be reduced to 3 by 10 microns. The transverse commissure of the ventral ducts is a straight tube 25-40 microns in diameter. Not infrequently the dorsal and ventral ducts are connected on the aporose side, at the posterior end. Normally the excretory ducts pass ventrad of the genital ducts. In two specimens however they are more often dorsad than ventral in those proglottids in which the genital pore is on the right side of the animal.

In the anterior aporose portion of the proglottid the ventral commissure becomes divided, and with the main ventral duct surrounds an "island" of medullary parenchyma which varies from 60 to 200 microns long (Figs. 4 & 9). Its long axis may be either longitudinal or transverse. From this region but varying considerably in point of origin a branch duct extends distad and mediad into the proglottid. This duct persists long after the uterus is formed, invested by its walls and projecting free into its cavity. Not infrequently a branch duct extends forward on the porose side of the proglottid also.

Nothing can be made out in the material at hand concerning the nervous system, except that a large main longitudinal trunk lies parallel to the dorsal excretory duct, laterad of it.

There is one set of reproductive organs in each proglottid, these alternating regularly in arrangement from right to left. The anlagen of the female organs may be made out in the first proglottid. Testes can be made out in about the fifteenth, and sexual maturity is reached in about the 40th.

The ovary is distinctly but not greatly displaced towards

the pore side of the median field. It is fan-shaped in outline, being formed of somewhat branched lobes radiating from the oöcapt thru about 230 degrees. For the first one-half of their length these lobes are largely fused with each other, so that the appearance of this portion is that of a continuous sheet pierced by scattered foremina. In cross-section the ventral limit is seen to be a straight line, while the dorsal limit is irregular. There is no suggestion of a bilobed condition. It is distinctly ventral in position except for a small portion near its median line where it projects far dorsad beyond the rest. In one specimen however most of the proglottids which have the genital pore on the right side have the ovary separated into distinct dorsal and ventral portions with only a narrow connection between. The dorsal portion, in these cases, is of about one half the area of the ventral, and thin. This individual is the one which showed the condition already mentioned of the excretory ducts passing dorsad to the genital ducts, and is one of the two showing the peculiar position of the vagina, to be mentioned later.

The yolk-gland lies posterior to the ovary, its centre on the porose side of the oöcapt. Usually it lies somewhat nearer the dorsal side than the ovary, sometimes extending nearly to the dorsal cortical layer, and dividing the testes into two fields. It is bilobed, the aporose lobe being much the larger; they are connected by a bridge at the ventral extremity. In cross-section it is distinctly horseshoe-shaped, the open face dorsad. Viewed frontally it is U-shaped, but with the aporose arm the larger. When seen from one side each lobe has roughly the outline of an isosceles triangle, with the base distad. The space of the U is occupied by

the shell gland, which needs no special mention.

The vagina communicates with the genital cloaca on the anterior surface of the latter. From here it extends forward and somewhat mediad, then turns towards the median line, its course lying proximad and ventrad of the cirrus pouch. In two individuals however the vagina, when on the right side of the strobila, lay more often dorsad to the cirrus pouch. Beyond the cirrus pouch it turns distad and mediad. Its middle portion in the anterior part of the proglottid is several times the diameter of the two ends. Its surface is thickly set with glandular cells. At about the level of the outer end the large somewhat elongated seminal receptacle measuring 130 by 180 microns springs from the dorsal surface of the inner end. It does not develop until very late.

Beyond the receptaculum the passage extends about 65 microns in the ventral part of the proglottid, to meet the oviduct of about the same length. The vitteline duct joins them and the common duct passes directly dorsad, thru the shell-gland. The uterine duct emerges from the dorsal surface of this gland and passes forward and somewhat laterad, just mediad to the receptaculum, to join the uterus.

The uterus cannot be distinguished in the material at hand until shortly before the eggs are ready to enter. In this stage it is represented by a simple transverse tube of very slight dorsoventral extension in the anterior part of the proglottid, and two more voluminous sacs, which extend distad, one on either side of the proglottid. The one on the aporose side lies just within the ventral excretory duct, and parallel to it; the one on the porose side follows the ventral limit of the vesicula seminalis as far as the cirrus pouch, along this to the excretory ducts and

then distad to the posterior/limit of the proglottid. From the distal end they extend mediad, to be separated, when they have reached their full developement, only by the narrow isthmus of the shell gland.

The developement is by extension and outpocketing. All three portions expand mediad, so that the cavity comes to occupy almost the entire median field. The distal sacs expand laterad so as to surround the excretory ducts, except at the region of the cirrus pouch. Pockets develop on all sides, so close together that their walls touch. This developement continues until nearly all of the internal organs are reabsorbed. The cirrus pouch and vesicula seminalis persist to the last, either in situ, or crowded to one side. The receptaculum seminis is represented by a mere vestige. The shell gland persists as a structureless mass connected with the posterior margin by a narrow isthmus. All the other organs are reabsorbed, the testes being the last to give away. The cortical layer is reduced to sometimes a thickness of 20 microns, the proglottid thus becoming little more than a thin-walled egg capsule.

The embryos in the uterus have three membranes. The outer is spherical and 30-40 microns in diameter. The middle membrane is irregular in outline, and lies close to the outer. The inner is closely applied to the embryo. The diameter of the embryo is 10-17 microns with very little variation as to size in an individual. There is a well developed pyriform apparatus, whose length, plus that of the embryo, is 16-26 microns. The two stout tapering horns extend forward parallel, then cross and extend distad as long slender processes.

The testes, 70-110 in number, are all dorsal and nearly all in the posterior half of the proglottid. They occur in both lateral

halves, but are much more numerous on the apopose side. At either side they are grouped two to three deep dorsoventrally; above the yolk-gland there is never more than a single layer, and sometimes they are wholly absent here, the testes being thus separated into two lateral groups. The testes are typically spherical in shape, and 30-45 microns in diameter, the average being 35.

The cirrus pouch is very large. Before the evagination of the procloaca (to be mentioned later) it lies usually entirely mediad of the excretory ducts, and at all stages more than half of it extend beyond them. In mature proglottids it is 275-370 microns long, and 120-140 broad. It is pearshaped, with the large inner end directed anteromediad. The cirrus is straight in the lateral half of the proglottid, and has two spiral turns in the median end. It is lined with many hundreds of hooks, four microns long, which are arranged in spiral rows. Two doubtful cases of extrusion of the cirrus have been noted; it is evident that this does not ordinarily occur.

The median end of the cirrus pouch is occupied by a portion of the seminal vesicle. Proximad and mediad to this is a second portion whose cavity is 25 microns in diameter by 140 long. Near its middle this portion bends sharply dorsad and returns; otherwise its course is straight. These two parts of the seminal vesicle are connected by a short duct of small diameter. The median portion is covered very thickly with prostate(?) glands. Beyond the seminal vesicle the passage narrows to a few microns, and soon divides, sending a branch to either testicular field.

The genital cloaca (fig.9) is small, and somewhat funnel-shaped. Its expanded median end embraces the base of the cirrus pouch. The vaginal opening is anterior to that of the cirrus pouch.

Laterally the cirrus pouch opens into a large very muscular pocket which I shall designate as the procloaca. Its size and shape vary considerably, depending upon the age of the proglottid and the stage of contraction; it may however be said to be about 140 microns long by 85 broad. The anlage of this structure can be made out first in about the 20th proglottid as a group of cells that stain deeply. Soon afterwards a small mass of cells, not distinguishable from the cuticula, with a small lumen in the centre can be made out near the lateral margin. This lumen increases in length mediad and then expands to a shape not unlike that of fig. 9 or fig. 10. Just at the maturity of the proglottid the cuticula of the outer body-wall is broken thru, thus giving access to the exterior. The pocket very soon turns inside out, projecting abruptly, in some cases for more than 200 microns beyond the margin. Fifteen or twenty proglottids farther back it is again retracted, to remain thus to the end. In its fully developed stage the cuticula and the wall of the pocket are directly continuous with the cortical layer and indistinguishable from it, except by position.

The specimens at hand give very little evidence as to the origin of this structure. The fact that it lies laterad of the cloaca and the fact that it is directly continuous with the cortical layer when fully developed, and that it is to all appearances identical in structure with it would suggest that it is an invagination of this layer. This cannot be however since its cavity does not connect with the exterior until it is completely developed. On the other hand it would be remarkable if a structure derived from the inner part of the proglottid could become so like the cortical layer as to be indistinguishable from it. I am inclined to believe that it arises by proliferation of the cells of the cortical

layer, and that the cavity arises by delamination after the proliferated cuticular cells have separated from the parental structure. There is nothing in the material at hand that would tend to contradict this view; and the lining of the cavity and the lumen itself can be seen to appear first very close to the external cuticula. It is my hope that I shall be able to settle this question when I have secured better material.

II- Relationships.

A consideration of the anatomical characters here noted makes it clear beyond doubt that this cestode belongs to the subfamily Anoplocephalinae, family Anoplocephalidae. It is also clear that it is closely related to the three genera Anoplocephala, Bertiella, and Schizotaenia, and is more distinct from the other genera of the subfamily. When however we try to decide to which genus it is more clearly related, we meet with serious contradictions. For comparison the diagnoses of the three genera are given below.

Anoplocephala E. Blanchard 1848. (From Bull. 69 U.S.N.M. - B.H.Ransom, 1909).

"Generic diagnosis.- Anoplocephalinae: Segments generally much broader than long, occasionally longer than broad. A single set of reproductive organs in each segment. Genital pores unilateral or irregularly alternate. Genital canals pass on the dorsal side of the longitudinal excretory vessels and nerve. Testicles and female glands in the median field; female glands towards the pore side of the segment, testicles toward the opposite side. Uterus a transversely elongated sac, with pocket-like appendages, anteriorly and posteriorly. Eggs with well-developed pyriform apparatus. Adults in mammals".

Bertiella Stiles and Hassal, 1902. (From Bull. 69 U.S. N.M. - B.H. Ransom, 1909).

"Generic diagnosis. - Anoplocephalinae: Segments always broader than long. A single set of reproductive organs in each segment. Genital pores regularly or irregularly alternate. Genital canals pass dorsal of longitudinal excretory vessels and usually dorsal of nerve. Testicles dorsal and anterior, extending in an unbroken mass from one side of the median field of the segment to the other as far as the excretory vessels.

Uterus transversely elongated with numerous outpocketings, anteriorly and posteriorly. Eggs with or without pyriform apparatus. Adults in birds and mammals".

Schizotaenia von Janicki, 1904e.

" Anoplocephalinen, deren Segmente breiter als lang sind. Genitalpori alternierend. Der Uterus bildet frühzeitig in den lateralen Partien sackförmige Erweiterungen, im übrigen Teil des Gliedes entwickelt er sich in Form eines komplizierten Spaltensystems. Genitalkanaele ziehen dorsal an den beiden Excretionsgefäßen und den Nervenstrang vorbei. Der engere, ursprünglich dorsale Gefäßstamm liegt lateral vom weitem Ventralgefäß. Der Komplex der weiblichen Drüsen aus der Medianlinie nur wenig verschoben. Das Hodenfeld erstreckt sich an der hinteren Gliedgrenze von Längsgefäß zu Längsgefäß. Cirrusbeutel stark muskulös. Eier mit birnförmigem Apparat".

In addition to the characterization here it may be added that in *Bertiella* and in *Schizotaenia* the diameter of the ventral canal is always more than ten times that of the dorsal, and the cirrus pouch does not reach beyond the ventral canal, or only

slightly so, while in Anoplocephala the ventral canal is never more than five or six times the dorsal in diameter, and the cirrus pouch reaches far beyond the ventral duct.

It will be seen from this description that the form which is being considered is like Anoplocephala and unlike the other two in the size of the cirrus pouch and its relation to the excretory ducts, and in the relation of the diameters of dorsal and ventral ducts to each other. It resembles Anoplocephala and Bertiella in that the uterus develops (partly) by outpocketing. It approaches Anoplocephala and is unlike the other two in that the testes are grouped towards the aporose side. On the other hand it possesses at least three characters which belong to one or both of the other genera alone. These are, the occurrence of the testes in both lateral fields, the regular alternation of the genital pores and the lateral distal sac-like extensions of the uterus.

The species agrees rather with Bertiella in the regularly alternating genital pores, and the occurrence of the testes in both lateral fields. It disagrees however in that the testes are posterior and grouped towards the aporose side, in the size of the cirrus pouch and its relation to the excretory ducts, the proportion of the diameter of the dorsal duct to the ventral, and in the presence of the lateral sacs of the uterus.

It is distinctly more like Schizotaenia in the possession of lateral sacs of the uterus, and in the posterior position of the testes. It is unlike the forms of this genus however in the asymmetrical grouping of the testes, the size of the cirrus pouch, its relation to the excretory ducts, the relative size of the dorsal and ventral ducts, and in the development of the uterus by outpocketing instead of splitting.

Thus it will be seen that this form has characteristics which belong to each of these three genera and also other characteristics which rule it out of each in favor of one of the others. There are also at least three characters which disagree with all three genera. These are: first, the extension of the uterus to surround the excretory ducts on either side; second, the occurrence of the testes in two distinct lateral groups, sometimes wholly separated, and never connected by more than a single dorsal layer; and third, in the possession of the procloaca, a character never before mentioned for a cestode.

A consideration of the combination which this form presents of the characters of its nearest allies and the three wholly distinctive characters mentioned, makes it evident that this form cannot be placed in any of the three genera, but must be considered the type of a new genus. Accordingly I have proposed for this species the name *Marsipotaenia geomyos*.

A study of the nearest allies of this form shows that the new genus is most closely related to the genus *Anoplocephala*, although in the distribution of testes, the only character that has been used to separate the two genera, it resembles rather *Bertiella*. It shows in not strictly fundamental characters, a close resemblance to *Schizotaenia hagmanni*. It cannot be said though that it is transitional, since it possesses so many distinctive characters. A careful consideration of the drawings and descriptions of *Schizotaenia hagmanni* and *S. decrescens* have made it seem to me not unlikely that von Janicki and Lühe were incorrect in their conclusions as to the method of development of this organ, and that in reality it is of the same type as mine. If this is so, the most important distinction has been explained away. There are other facts also that have caused me to doubt the validity of von Janicki's genus. However

data are not at hand at present to justify any conclusions on this point. It is my hope that I shall be able to have material representing three of the species of this genus for study next year; until then, nothing can be decided.

The diagnosis for the genus *Marsipotaenia* is as follows.

Anoplocephalinae, with segments broader than long. Dorsal excretory duct laterad of the ventral, in the same plane. diameter of ventral duct less than six times that of the dorsal. A single set of reproductive organs in each segment. Genital pores regularly alternating. Genital cloaca opening into a large, very muscular pocket, the procloaca. Genital canals pass dorsal of the longitudinal excretory vessels and nerve, the cirrus pouch entirely mediad of both ducts when not extruded, and always reaching considerably beyond them. Testes nearly all in the posterior half of the segment, in two separate groups, or not connected by more than a single layer, the group on the asporous side much the larger. Female glands slightly displaced towards the pore side. Uterus at first a transverse bar in the anterior part of the proglottid, with a distal sac-like extension at either side; development by extension and outpocketing. Uterus in ripe proglottids occupying almost the entire space of the proglottid, and extending laterad of the excretory ducts and surrounding them. Eggs with well developed pyriform apparatus. Adults in mammals.

Type species, *Marsipotaenia geomyos*. Type locality, Norman Oklahoma.

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1906.- Studien an Säugetiercestoden. Zeitschrift für wissenschaftlichen zoologie, Bd. 81 Sn. 582-590, mit Tafeln.

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Ransom, B. H.

1909. The Taenioid Cestodes of North American Birds. Bull. 69 U. S. N. M.

Explanation of figures.

Fig. 1.- Outline of complete worm, seven times natural size.

Fig. 2.- Outline of anterior part, larger scale.

Fig. 3.- Slightly oblique section thru the scolex at about the middle of the suckers.

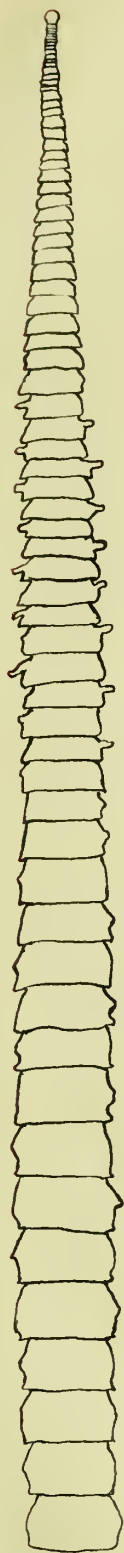
Figs. 4, 5, and 6.-Dorsal views of proglottids, to show excretory ducts and male genitalia.

Figs. 7, 8. Cross sections of mature proglottids to show same structures.

Fig. 9.-Dorsal view of proglottid, to show excretory ducts, female genitalia, cloaca and procloaca.

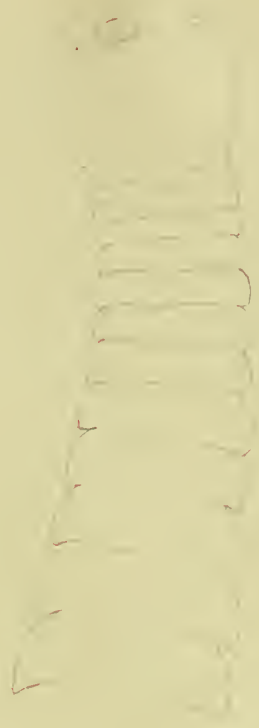
Fig. 10.- Outlines of successive proglottids, to show eversion of procloaca.

Fig. 11.- Outline of uterine embryo with pyriform body.



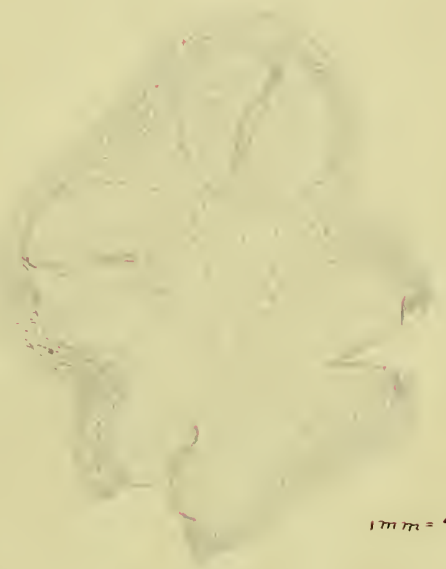
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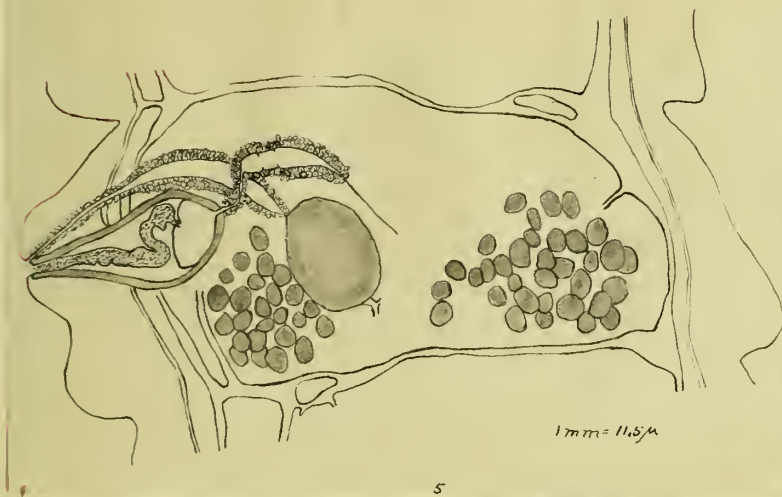
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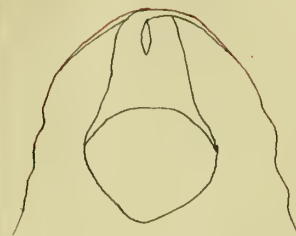
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1 mm = 0.65 μ

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